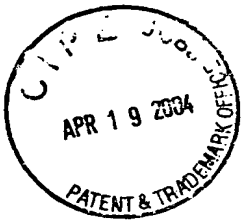

DECLARATION

I,Noboru YOSHIDA, of SHIGA INTERNATIONAL PATENT OFFICE, 2-3-1, Yaesu, Chuo-ku, Tokyo, Japan, understand both English and Japanese, am the translator of the English document attached, and do hereby declare and state that the attached English document contains an accurate translation of the official certified copy of Japanese Patent Application No. 2000-202844 and that all statements made herein are true to the best of my knowledge.

Declared in Tokyo, Japan

This 9 th day of April, 2004

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(List of Documents Submitted)

(Item)	Specification	1
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[Document Type] SPECIFICATION

[Title of the Invention] FRICTION REDUCING SHIP

[Claims]

[Claim 1] A friction reducing ship that reduces frictional resistance of a ship body by ejecting gas bubbles on a submerged surface of the ship body, comprising:

a discharge opening disposed on the submerged surface of the ship body for ejecting the gas bubbles into the water; and

a fluid passage having one end open to a gaseous space and having the other end open in the water by way of the discharge opening; wherein

at least a portion of the fluid passage is formed by a member constituting an outer shell of the ship body.

[Claim 2] A friction reducing ship according to claim 1, wherein said at least a portion of the member forming the fluid passage is a member for reinforcing the ship body.

[Claim 3] A friction reducing ship according to claim 1 or 2, wherein the fluid passage is divided into a plurality of passages.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

This invention relates to a friction reducing ship in which frictional resistance of a ship body is reduced, and in particular, to planning for the reduction of the construction costs of the ship body.

[0002]

[Prior Art]

Conventionally, for the purpose of reducing energy consumption when a vessel or the like is cruising, techniques have been proposed relating to friction reducing ships in which a gas is ejected into the water and frictional resistance between a ship body and the water is reduced by interposing a multitude of bubbles in the vicinity of the surface (submerged surface) of the outer hull of the ship body.

[0003]

Techniques of generating bubbles in the water are proposed in Japanese Unexamined Patent Applications, First Publication Nos. Sho 50-83992, Sho 53-136289, Sho 60-139586, Sho 61-71290, and in Japanese Unexamined Utility Model Applications, First Publication Nos. Sho 61-39691 and Sho 61-128185.

[0004]

In these techniques, methods for generating bubbles in the water rely on equipment such as pumps and blowers to eject pressurized gas into the water from discharge openings provided on the ship body.

[0005]

Furthermore, structures which provide a network of pipes and ducts throughout the interior of the ship body leading to a pressuring apparatus or to a discharge opening are general structures for directing gas into the water from a gaseous space.

[0006]

[Problems to be Solved by the Invention]

However, since the friction reducing ships described above provide piping networks in the interior of the ship body as the structure for directing gas into the water, the piping must be installed while avoiding interference with other equipment, so that the construction costs tend to be high because of problems such as labor-intensive

construction tasks and a large number of parts required for the structure.

[0007]

This invention is provided in view of the above circumstances, and the objective of the invention is to provide a friction reducing ship with which it is possible to easily plan for reduction of construction costs of the ship body.

[0008]

[Means for Solving the Problems]

In order to solve the above-mentioned problems, the invention according to claim 1 adopts, in a friction reducing ship for reducing the frictional resistance of a ship body by ejecting bubbles on the submerged surface of the ship body, a technique of providing a discharge opening provided on the submerged surface of the ship body for ejecting bubbles into the water, and a fluid passage having one end open to a gaseous space and having the other end open to the water by way of the discharge opening, wherein at least a portion of the fluid passage is formed by a member constituting an outer shell of the ship body.

Furthermore, the invention according to claim 2 adopts, in the friction reducing ship according to claim 1, a technique in which at least the portion of the member forming the fluid passage is a member for reinforcing the ship body.

Furthermore, the invention according to claim 3 adopts, in the friction reducing ship according to claim 1 or 2, a technique in which the fluid passage is divided into a plurality of passages.

[0009]

According to this invention, since a fluid passage is formed by a member constituting the outer shell of the ship body, there is no need to install new piping for

directing gas into the water, and it is possible to plan for a reduction in construction costs by reducing the members and labor required in construction tasks. Furthermore, by having the ducts which form the fluid passage serve as members for reinforcing the ship body, it is possible to maintain a high degree of design freedom such as setting the ducts at arbitrary positions and at many locations in the ship body. Moreover, by dividing the fluid passage into a plurality of passages, it is possible to selectively use the plurality of fluid passages.

[0010]

[Embodiments of the Invention]

Below, an embodiment will be described with reference to the figures, wherein the friction reducing ship according to this invention is applied to a bulk ship such as a tanker or freighter. In Fig. 2, reference symbol M is a friction reducing ship, 10 is a ship body, 11 is a bubble generation apparatus, 12 is a ship body outer hull (submerged surface), 13 is a screw, 14 is a rudder, and 15 is the water surface (waterline).

[0011]

A VLCC (Very Large Crude Oil Carrier), for example, corresponds to the bulk ship as the friction reducing ship M. In comparison with other types of vessels, the surface area on the bottom of the ship is formed to be relatively large in comparison with the side of the ship in the ship body outer hull 12 (submerged surface) which is beneath the waterline 15.

[0012]

As shown in Fig. 2(b), the bubble generation apparatus 11 is provided with a discharge opening 20 disposed on the submerged surface 12 (bottom of the ship in this case) of the ship body; a fluid passage 21 having one end open to a gaseous space by way

of an air intake opening 21a and the other end open to the water by way of the discharge opening 20; and a negative pressure forming section 22 for forming a negative pressure region, having a lower pressure relative to the gaseous space (atmosphere) due to the relative flow of water during cruising, in the water near the discharge opening 20.

[0013]

The negative pressure forming section 22, in this case, is disposed so as to protrude from the submerged surface 12 of the ship body, and changes the flow of water flowing along the submerged surface 12 of the ship body during cruising so as to form a negative pressure region in the water at its rear portion by the actions of stream separation, cavitation, or lowering in static pressure accompanying an increase in flow velocity.

[0014]

In the friction reducing ship M of such a constitution, a negative pressure region 31 is formed in the water (refer to Fig. 2(b)) when it is in cruising mode, so that the pressure at the discharge opening 20 facing the negative pressure region 31 in the water is low compared to the pressure at the air intake opening 21a of the fluid passage 21, a pressure gradient force is applied to the fluid in the fluid passage 21 and the air flowing from the air intake opening 21a is ejected into the water from the discharge opening 20. Then, the gas delivered into the water becomes mixed in the water as air bubbles 32, which intervene in the vicinity of the submerged surface 12 of the ship body 10 to lead to reduction in the frictional resistance of the ship body 10.

[0015]

However, in this friction reducing ship M, the fluid passage 21 is formed by a member constituting the outer shell of the ship body 10.

[0016]

Specifically, as shown in Fig. 1, the fluid passage 21 is formed as the internal gaseous space of ducts 40, 41 installed along the ship body outer hull 12 extending from the deck area to the ship bottom 10d. The ducts 40, 41 are used as members for reinforcing the ship body 10, in this case, as members for reinforcing the ship body outer hull 12.

[0017]

Fig. 1(b) shows the cross sectional structure of the ducts 40, 41. That is, the ducts 40, 41 are connected to the ship body outer hull 12 so as to form a fluid passage therein (fluid passage 21) having a specific cross sectional area. Here, in Fig. 1(b), it should be noted that, although the ducts 40, 41 form fluid passages having a rectangular cross section, they are not limited to this, and fluid passages having shapes other than a rectangle may be formed. The shape of the ducts 40, 41 and the shape of the fluid passage 21 serving as its internal space are suitably determined on the basis of the shape and the like of the ship body 10 so as to enable the fluid to move at a low pressure loss.

[0018]

Also, Fig. 1(c) shows a plan view of the installation state of the ducts 40, 41 as seen from above the ship body. In this embodiment, the ducts 40, 41 are divided into a plurality of ducts (two in this case) for the starboard side 10b and the port side 10c, and, accordingly, the fluid passage 21 is also divided into left and right side passages. The material of the ducts 40, 41 preferably includes metals which have undergone some corrosion resistant treatment, for example, so that the surface is corrosion resistant mainly to seawater and resistant to attachment of marine organisms.

[0019]

In the friction reducing ship M in this embodiment, the fluid passage 21 is formed

by the ducts 40, 41 which are members that constitute the outer shell of the ship body 10 so that there is no need to newly install piping for guiding gas into the water, thereby enabling a reduction in the members and the labor required for ship building to make it possible to easily plan for reduction in the construction costs. Especially, the bubble generation apparatus 11 provided in this embodiment adopts a method of forming a negative pressure region within the water and directing a gas into the water using a pressure gradient force so that, in comparison with the conventional method of providing a compressing apparatus, there are advantages, such as there being no need for an apparatus to compress the gas and a very elementary structure, thereby enabling a reduction in the construction costs.

[0020]

Also, in this friction reducing ship M, the ducts 40, 41 are installed along the ship body outer hull 12 so that the internal space of the ship body 10 can be utilized very effectively. Further, in this embodiment, the ducts 40, 41 are divided into a starboard side 10b as well as a port side 10c, and the fluid passage 21 is also divided; therefore, each air intake opening 21a in a plurality of fluid passages 21, for example, can be opened selectively to enable easy adjustment of the amount of bubbles discharged.

[0021]

Fig. 3 shows another embodiment of the friction reducing ship according to this invention.

In this embodiment, different from the above embodiment, the fluid passage 21 is formed by ducts 50, 51, 52 disposed along the ship body outer hull 12 from the starboard side 10b to the port side 10c. Also, the ducts 50, 51, 52 are installed in plurality from the bow of the ship 10a toward the stern of the ship with spaces in between, and a plurality of

discharge openings 20 and negative pressure forming sections 22 are provided on the ship bottom 10c to correspond with the fluid passages 21 formed as the internal spaces of each of the ducts 50, 51, 52. Similar to the preceding embodiment, the ducts 50, 51, 52 in this embodiment are also members which constitute the outer shell of the ship body 10 as well as which reinforce the ship body 10.

[0022]

In this embodiment, because the fluid passages 21 are formed by the ducts 50, 51, 52 disposed from the starboard side 10b to the port side 10c, less restriction is placed on the location of the discharge openings 20 and the negative pressure forming sections 22, thus making it possible to locate the discharge openings 20 in arbitrary locations along the width direction of the ship. Moreover, because a plurality of fluid passages 21 are formed at a specific spacing from the bow of the ship 10a to the stern of the ship, it is possible to divide the discharge openings 20 along the longitudinal direction of the ship. That is, it becomes possible to dispose a plurality of discharge openings 20 on the ship bottom 10c so as to distribute the bubbles over a wide area of the submerged surface and to plan for improvement in the effect of reducing the frictional resistance. In addition, the ducts 50, 51, 52 that form the fluid passages 21 are members for reinforcing the ship body 10, and therefore, a high degree of design freedom is possible such as easily implementing the provision of a plurality of ducts on the ship body 10 and disposing the ducts at arbitrary locations as in this embodiment. Furthermore, by providing a plurality of spaces beforehand serving as the fluid passages 21 as in this embodiment, even after the completion of constructing the ship body 10, it is possible to provide discharge openings 20 for ejecting bubbles, as required.

[0023]

Also, the shapes and combination of each component shown in this embodiment are just examples, and various modifications within the scope of this invention based on design requirements are possible. For example, in the above embodiment, an example of applying this invention to a bulk ship is given, but it is not limited to such an application, and it is applicable to other ships such as high-speed ships and fishing vessels. Furthermore, the size, number and location of the bubble generation apparatus 11 are appropriately chosen according to the shape of the ship body.

[0030]

[Effects of the Invention]

As described above, according to this invention, since the fluid passages are formed by members that constitute the outer shell of the ship body, it is possible to reduce the needed members and labor needed in construction tasks as well as easily plan for reduction of the construction costs.

[Brief Description of the Drawings]

[Figure 1] This is a conceptual drawing showing the installation state of the ducts in the friction reducing ship according to this invention; (a) is a vertical sectional view of the ship body seen from the front, (b) is a magnified view of the cross section of a duct, and (c) is a plan view showing the installation state of the ducts in the vicinity of the bow of the ship as seen from above the deck.

[Figure 2] This is a view showing one embodiment of the friction reducing ship according to this invention.

[Figure 3] This is a plan view showing another embodiment of the friction reducing ship according to this invention as seen from the ship bottom.

[Brief Description of the Reference Symbols]

10 ship body

10a bow of ship

10b starboard side

10c port side

10d ship bottom

11 bubble generation apparatus

12 ship body outer hull (submerged surface)

20 discharge opening

21 fluid passage

22 negative pressure forming section

31 negative pressure region

32 bubbles

40, 41, 50, 51, 52 ducts

[Document Type] Abstract

[Abstract]

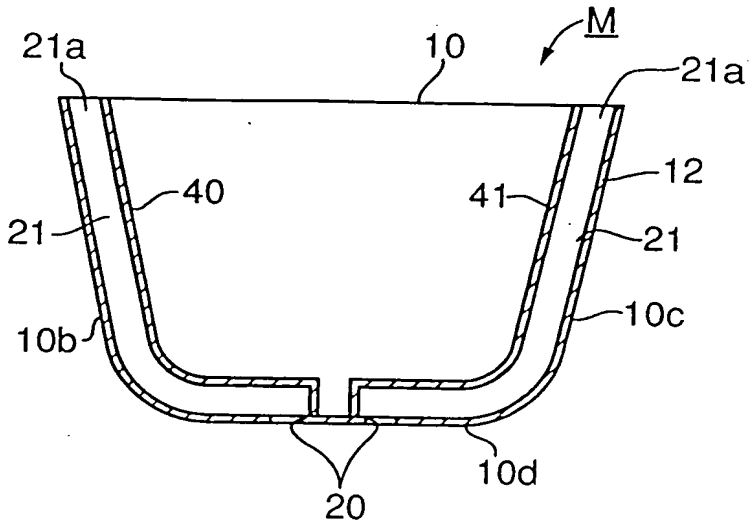
[Problem] To provide a friction reducing ship, in which it is possible to easily plan for a reduction in the construction costs of a ship body.

[Means for Solving the Problem] A discharge opening 20 for ejecting bubbles into the water, and a fluid passage 21 having one end open to a gaseous space and having the other end open in the water by way of the discharge opening 20 are provided, and at least a portion of the fluid passage 21 is formed by a member which constitutes the outer shell of a ship body 10.

[Elected Drawing] Figure 1

FIG. 1

(a)



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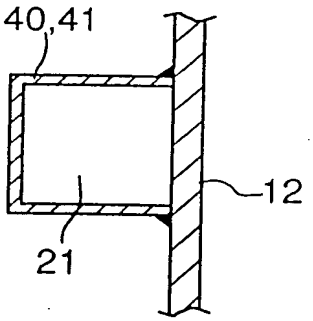

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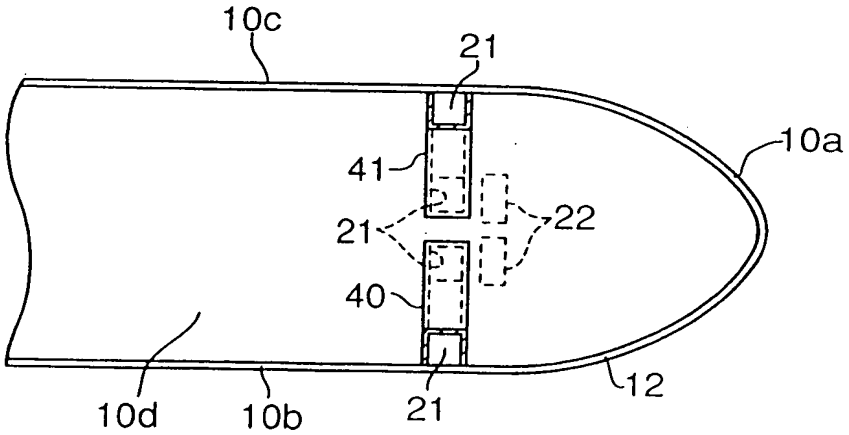
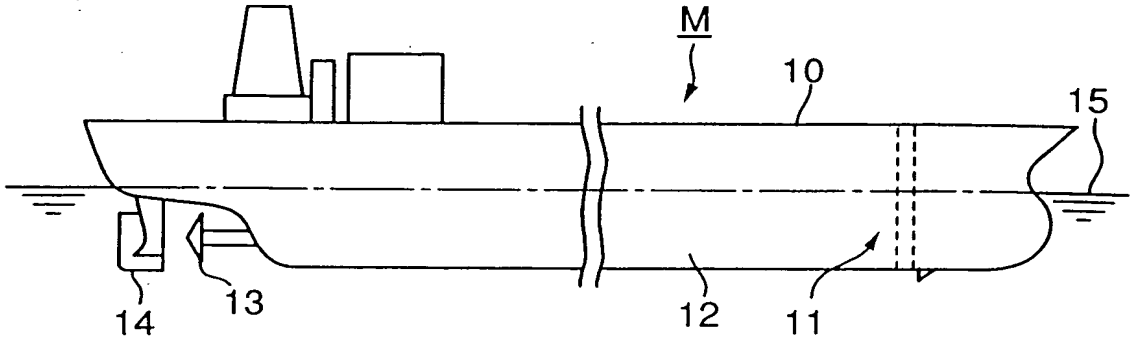


FIG. 2

(a)



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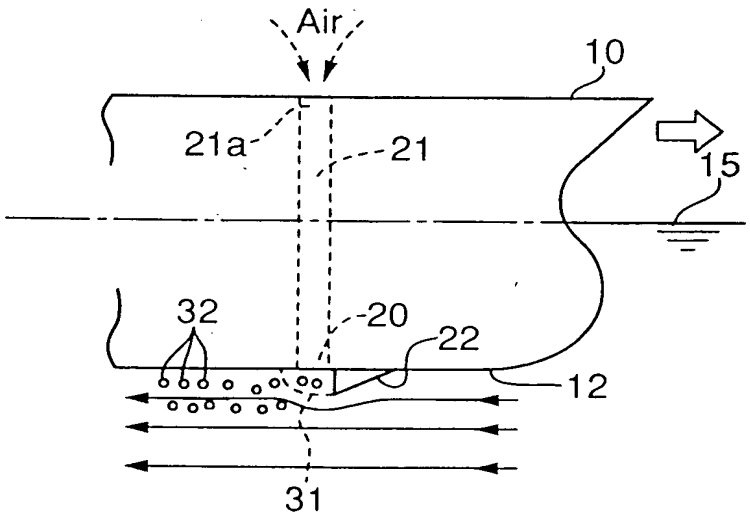

FIG. 3